Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Inquiry Regarding Carrier Current	)	
Systems, including Broadband over	)	ET Docket No. 03-104
Power Line Systems	)	

REPLY COMMENTS OF
GARY W. BOX
To Comments of
PPL Telecom
Dated 7 July 2003

These are Reply Comments of Gary W. Box to comments filed by PPL Telcom, LLC.

The writer received a BSEE and MSEE from UCLA, 1977 and has been employed as a electrical engineer involved in the power electronics and industrial electronics industries for 29 years, mainly in product development. This experience includes numerous encounters with FCC emission requirements including designing, building and testing equipment for compliance. The writer has also been issued 9 patents and currently holds the call sign N0JCG as a member of the Amateur Radio Service.

These replies take the form of excerpts from PPL Telcom's original comment, noted as "Comment," followed by reply remarks, noted as "Reply". A number annotates each Comment and Reply. Replies commence immediately below.

1. COMMENT
" If adequate signal backhaul capability is available, BPL can utilize existing electric distribution infrastructure and can be deployed to provide broadband service to under-served areas."

REPLY
BPL is not the most economical, easiest deployed, or reliable of the choices available to the utility. I would like to remind the Commission of their recent work on establishing the Unlicensed National Information Infrastructure band at 5Ghz. The very function of Access BPL is to be part of this infrastructure. It seems only logical that the utilities also use the U-NII band for this purpose. By mounting U-NII nodes on power poles at appropriate intervals (between 1 and 10 miles), All the goals of the Commission, the utilities and even the manufacturers can be achieved without causing interference to any HF users. Perhaps more importantly, U-NII implementations such as the Motorola Canopy system can be deployed immediately, without any further Commission action or cost to the Federal Government.

The advantages of using the U-NII band over BPL are numerous:

1. No interference to any users in HF.
2. No need for frequency notches.
3. No direct connection to power line, other than for power.
4. Independent of powerline noise.
5. Independent of powerline impedance characteristics.
6. Independent of power grid switching
7. Independent of powerline reliability, with battery backup.
8. Independent of powerline routing. Only pole location is important.

9. Freedom to configure the network as desired; either with directional antennas or omnis.
10. No safety concerns.
11. No interference liability for the utility.
12. Cheaper hardware (5Ghz transverter should be cheaper than powerline inductive components).
13. Lower radiated RF power
14. Lower power consumption overall. Could be solar powered
15. System robustness
16. FCC gets its "third wire".
17. Providing rural service is trivial.
18. Strap-on installation means neighborhoods could be "wired" in hours, not months.
19. Cheaper installation
20. Little or no rule changes needed.
21. Bandwidth is almost four times wider than BPL, leading to higher performance.

2. COMMENT

" The two technology providers presently supplying equipment to PPL Telecom (Main.net and Amperion) have completed extensive FCC testing for compliance certification and have attached FCC stickers on their BPL equipment. BPL technology providers have taken, through product design and independent testing, great efforts to ensure that their technology does not interfere with users of FCC regulated radio bands and will meet FCC Part 15 requirements."

REPLY

All BPL proponents, PPL Telecom included, are under the mistaken notion that the Part 15 emission limits are a sort of digital threshold, below which there is no interference and above which there is. Harmful interference is defined as any repeated interruption of a licensed service, regardless of the RF field level from the offending device. A sticker does not make a device comply with FCC Part 15 rules, only the absence of harmful interference to any licensed service when it is operation will do that. Recent tests by the American Radio Relay League (ARRL) using a conventional mobile amateur radio configuration documented substantial harmful interference from several BPL systems. Main.net, Amperion and others have described their BPL systems as a wide band system using OFDM modulation to avoid frequencies in the amateur bands. Let's assume that a spectrum analysis of the BPL signal shows no BPL carriers in the amateur bands. How then did the sensitive narrow bandwidth amateur receiver pick up the out of band BPL signal? If we examine the characteristics of the received noise, we see that most of the interference is a series of random 'pops', which one party described as sounding like a 'Geiger counter'. They were very short, but very often, impulse noise transients. OFDM modulation creates 256 (or more) discrete RF carriers and imposes a separate bit stream on each. The 256 carriers suddenly appear, transmit their bit streams, which form the packet, and then are extinguished. If the leading and trailing edges of these carriers are fast, the edge of each packet will look like an impulse excitation to the power line. The spectrum of an impulse is spread infinitely across the spectrum. The power line obediently reacts to this excitation as the distributed, unbalanced, resonate wire structure it is and an impulse of energy is radiated all across the HF spectrum. The phenomena would occur at every edge of every packet.

In the Amateur Radio Service this effect has been known for 80 years as "key click". A CW (Morse code) transmitter operates by turning the carrier on and off as the key is opened and closed. In much the same way that the BPL OFDM signal turns its 256 carriers on and off at the beginning and end of the packet, although at a considerably slower rate. In CW, 'key click' is fixed by controlling the rise and fall times of the RF envelope, effectively passing the RF envelope through a low pass filter.

Unfortunately for BPL, passing the signal through a low pass filter will slow the baud rate substantially. OFDM works great in a band where all users are using the same modulation scheme because OFDM itself has good immunity to this effect. This is why there should be no conflict between access and in-home BPL. However, on the HF band, where the development emphasis over the last 100 years has been on raising signal to noise performance by designing ever-sharper filters and highly bandwidth conserving modulation schemes, a mode that continually generates impulse noise is incompatible.

3. COMMENT

" PPL Telecom supports the application of existing FCC Part 15 radiated compliance rules to govern both BPL access and in-home BPL technologies at this time. Future increases in radiated emission limits for BPL access equipment may be warranted as indicated by ongoing testing and technological developments."

REPLY

I agree that FCC Part 15 rules should govern both BPL access and in-home BPL technologies. FCC Part 15 requirements include the provisions that the device must not interfere with licensed services and those devices must accept any interference from licensed services. The inability of first generation HomePlug devices to meet this provision resulted in a recall and redesign. The remedy used at that time, notch filters at amateur radio bands, is inappropriate for access BPL because the power distribution lines make a much better antenna at HF than in house wiring and have been shown to radiate accordingly. Is PPL Telecom prepared to shut down their BPL system when it is shown to cause harmful interference to the Amateur Radio Service, short-wave broadcasting , FEMA , National Bureau of Standards or any other licensed HF user? Is PPL Telcom prepared to accept the interruption of their BPL service every time a local, legal transmitter in the 2 to 80 MHZ band keys up?

4. COMMENT

" FCC Order 97-Section 157 essentially places the burden on BPL opponents to justify blocking a new entrant or technology that may provide more affordable telecommunications services to a broader base of customers. PPL Telecom believes that the arguments raised by amateur radio forums do not meet this burden and do not provide any direct evidence that BPL vendors' technologies cause interference in excess of approved limitations established by FCC guidelines."

REPLY

There are three reasons why BPL should not be allowed to inject high frequency RF energy onto the power lines.

1. All BPL manufacturers and proponents, PPL Telcom included, admit that to achieve adequate performance they must increase conducted RF energy levels well above the Class A limit imposed by the FCC. These limits were established and harmonized worldwide to prevent spurious RF emissions from power lines taking into account variations in lines, contact rectification and other power line anomalies. The power line doesn't distinguish between RF energy from noise and RF energy intentionally injected from a BPL system and will respond the same to both. Allowing BPL to inject HF RF energy into the power line will negate almost 20 years of progress in preventing RF emissions from power lines. Furthermore, BPL spread spectrum and OFDM modulation schemes have been shown to inject impulse like noise onto the power lines and are thus incompatible with narrow band, licensed HF users. Simply put; these systems will interfere with HF users.
2. All BPL equipment must have a RF receiving section, and a fairly broad one at that. The equipment will receive and respond to any RF energy in its passband including that from nearby legal HF services. Even the near field from a 5-watt amateur transmitter will saturate the front end of a BPL receiver. A perfectly legal 10-meter CW beacon at 28.25MHz running 100 watts in the typical residential backyard would render a local BPL system worthless. Simply put; legal HF users will interfere with BPL systems.
3. The entire concept of injecting high frequency RF into the power line is not necessary, and in fact has been made obsolete by the availability of the frequency allocation for the Unlicensed National Information Infrastructure at 5GHz. By the proponents' insistence that this system is intended to bring broadband Internet to the masses, BPL is part of the Unlicensed National Information Infrastructure and should use the frequency allocation set aside for that purpose. This is not a bad thing. In fact, by so declaring, the FCC will harmonize the U-NII picture and deployment can begin tomorrow with existing equipment and no additional rulemaking and no additional testing.

4.

BPL should not proceed because the opportunity cost of injecting RF onto the power line is too high and it is not necessary.

Respectfully Submitted;

Gary W. Box